MARICOPA ASSOCIATION of GOVERNMENTS

MAG Regional Concept of Transportation Operations

Technical Memorandum No. 4

- Policies and Practices Needed to Achieve Operational Goals

Prepared by:

Kimley-Horn and Associates, Inc.

In association with:
Transmart Technologies, Inc.
PB Farradyne

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1. INTRODUCTION

The purpose of the Regional Concept of Transportation Operations is to foster a higher level of integration and coordination among agencies responsible for transportation operations in the MAG region. Technical Memorandum No. 4 presents the results of Task 5: Recommend Policies and Practices Needed to Achieve Operational Goals.

1.1 Memorandum Contents

Specifically, this memo contains:

- Story-line operational concepts outlining the roles and responsibilities of each agency with respect to normal transportation operations, including transit, as well as incident management and emergency management agencies;
- Identification of areas where it may be essential to establish regional operational policies and practices; and
- Recommendations for new and/or modifications to existing policies and practices needed to achieve the operational goals that were presented in Technical Memorandum No. 3.

1.2 Review of Vision and Mission Statements

The stakeholders in the MAG region envision a safe, reliable, efficient, and seamless surface transportation system. This will be achieved by:

- Identifying and securing funding sources;
- Actively managing and operating multimodal transportation systems;
- A high degree of information sharing, integration, and coordination;
- Defining and agreeing to appropriate roles and responsibilities;
- Establishing and implementing applicable policies, procedures, and practices;
- Dedicating and training human resources; and
- Continuous improvement of performance against customer driven indicators.

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2. OPERATIONAL CONCEPTS

Operational concepts were developed for each of the transportation systems operational centers. These include:

- Regional Traffic Operations Center (ADOT TOC);
- Local City/County Traffic Management Center;
- Local City/County/State Emergency Services Center;
- Transit Control Center; and
- State and County Emergency Operations Centers.

The proposed Operational Concepts for each transportation system are described in "a-day-in-the life" terms:

- How the different systems and subsystems will work together;
- How the agencies and operators will interact in daily operational situations;
- How traffic operations is managed; and
- How travel information is disseminated to the public.

The objective of the operational concepts is to describe how transportation professionals—including traffic and transit planners, engineers, operators, and maintenance personnel—and emergency services professionals can better work together, on a daily basis, to improve transportation operations in the MAG Region.

2.1 Regional Traffic Operations Center

The ADOT TOC is the control center for the Urban Freeway Management System and houses the AZTech™ central server. The AZTech™ system allows for center-to-center communications, thus facilitating the sharing of transit information, instant messaging between centers, shared control of closed-circuit television (CCTV) and variable message signs (VMS), transfer of signal system and detector data, and input of information into the HCRS.

Freeway Management

The TOC operators have primary operating control of the video surveillance cameras (CCTV) and variable message signs (VMS) deployed on the valley freeways. Traffic volumes and vehicle speed occupancy data from detectors on the freeways also are sent to the TOC.

When the TOC operator detects unusual circumstances (heavy congestion) on a freeway segment or at an interchange he/she will first determine the cause of the congestion levels. If the congestion involves the traffic signal at the interchange, he/she will telephone the affected city Traffic Management Center (TMC) and discuss the cause and potential remedies, provided that agency controls that particular traffic signal system; otherwise, the operator will contact the appropriate ADOT traffic signal troubleshooting team.

If appropriate, and in consultation with traffic engineers from the local cities, the TOC operator may post messages on the VMS advising travelers of the congested area so travelers may select alternate routes. The TOC operator will adhere to the practices agreed upon concerning the routing of freeway traffic onto arterials.

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When the local Traffic Management Centers are not operational—for example, after hours—the TOC operator's responsibility increases. Under such circumstances, the TOC operator is responsible for the after-hours monitoring of the local traffic signal system and ITS field devices. In the event of an after-hours (for the local TMC) incident, the TOC operator is responsible for contacting the local city TMC operators via a pager or telephone, informing them of the incident and advising of the potential impacts to arterial traffic. The TOC operator, with the permission of the local TMC, may also remotely post messages to arterial VMS and to implement pre-agreed upon signal timing plans.

Freeway Incident Coordination and Response

The TOC helps to coordinate interjurisdictional response to incidents on the freeways. One of the primary duties of the TOC operator is to detect and verify incidents on valley freeways and arterials when possible. An incident may be detected in one of five ways:

- DPS informs the TOC operator of an incident;
- DPS provides automated notification of incidents to TOC via CAD system;
- Incident is reported to the TOC by ADOT field personnel or other source;
- Incident is detected by the TOC operator via video monitors displaying CCTV images; or
- Incident is detected by the TOC operator via detectors indicating a drop in speeds or an increase in occupancy.

If the incident is reported to the TOC, the TOC operator's first action is to verify the incident via the video monitors if the incident has occurred within the limits of the instrumented freeways. Upon verification via the video monitors, the TOC operator must determine what resources are needed and then convey this information to DPS dispatchers. The DPS dispatchers also may view the CCTV images on monitors at the DPS Emergency Dispatch Center.

After the initial evaluation of the incident scene, the CCTV cameras will be used to monitor incident related congestion. The TOC operator will coordinate any further response with DPS and local police/fire, traffic, and transit agencies as applicable. Incident information is entered into the HCRS as soon as the incident has been confirmed.

A key function of the TOC operator is continued coordination with the affected cities and agencies. When the traffic incident might affect facilities belonging to a city, the TOC informs the local TMC operator/traffic engineers of the incident, and provides them with as much information as possible.

When the incident might affect traffic on facilities belonging to multiple jurisdictions, the TOC operator helps to coordinate the responses of the local cities and counties in the affected jurisdictions. Examples of possible responses would include using arterial variable message signs to inform travelers of the incident and of suggested alternate routes, or implementing different signal-timing plans to accommodate changes in traffic patterns due to the incident.

If requested by DPS, the ALERT will be dispatched to the incident scene. The ALERT will provide traffic control in conformance with MUTCD standards, which requires incidents to be treated as temporary work zones. If DPS determines that the ALERT should be dispatched to the incident scene, the ALERT reports to the DPS Incident Commander.

Through the use of CCTV cameras, the TOC operator determines when the incident has been cleared and alerts the local TMC operators in the affected jurisdictions of the incident clearance.

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The TOC operator inputs the updated incident status into the HCRS to disseminate the information as widely as possible. The HCRS automatically updates the information to the 511 telephone system and the 511 web site.

2.2 Local City/County Traffic Management Center

Each local city and county traffic management center consists of an AZTech™ workstation for interagency data exchange and an ATMS workstation to control the city's own traffic signals. The local TMC maintains control of any field equipment, such as CCTV cameras and dynamic message signs, within their jurisdiction. In most cases the local TMCs will not be staffed by full-time operators, but rather will be available for use during business hours or on an as-needed basis by traffic and maintenance engineers in each city.

Arterial Management

A core function of the local TMC is to coordinate signal operations within a city and with those of neighboring jurisdictions. Ideally, the local TMC operator/traffic engineer will have an interface that can upload the signal-timing plans for each of the city's signals to the AZTech™ server, facilitating cross-border signal coordination. The timing plans will be named according to the agreed upon regional standard conventions. The TMC operator/ traffic engineer also will upload traffic count data for use by other agencies.

An additional level of signal operations integration would include the division of traffic signals into coordinated signal groups. The groups of signals may include signals operated by one or more agency. In this case, one agency will be designated to control all of the signals in the coordinated signal group.

As a part of daily activities, planned events and construction work zones are input into HCRS, allowing this information to be shared with other agencies and the general public through the ATIS/511 system.

All traffic signals equipped with emergency vehicle preemption will be implemented according to the agreed upon regional standard. Phasing during preemption (whether left turns are permitted, etc.) and the distance before preemption is activated will be consistent irrespective of the city. Each emergency vehicle with a preemption transponder will be assigned an identification number that allows the vehicle to be identified as it preempts the signal system.

Arterial Incident Management

Local Traffic Management Centers play a vital role in effective incident management. Ideally, each local TMC notifies the ADOT TOC of incidents that may impact freeway interchanges. Likewise, the TOC notifies local TMCs of incidents that may impact the interchanges and adjacent arterials. Each agency makes appropriate changes to signal systems and ramp meters under their control and jurisdiction. When changes are made, each agency then notifies the other of the actions taken.

The sharing of information between agencies is critical to improved arterial incident management. Video images are accessible to any agency that desires the information. Local cities, although unable to control the equipment of another local city without permission, can view the roadway network in an adjacent city through the AZTech™ workstation. Thus, an operator of City A can better gauge the impact an incident in City B will have on roadways that connect City A with City B.

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After normal working hours, the cities allow the TOC to monitor the signal systems. Should an incident require traffic signal timing modification on a local arterial or the posting of a message to an arterial VMS, the TOC operator contacts the designated local TMC representative by telephone or pager. The representative of the local TMC returns to the local TMC and implements the requested changes.

Over time, as cooperation between the TOC and local TMC facilities grows, and as capabilities and experience with incident response increases, the local traffic engineer may decide that future incidents can easily be handled by the TOC without needing to first consult the local TMC operator. If such is the case, the local traffic engineer will reach an agreement with the TOC manager determining which circumstances will not require prior approval to implement a plan change. The TOC operator will have the capability to remotely change signal timing plans and will be able to post messages to the arterial VMS.

2.3   Local City/County/State Emergency Services Center

These emergency services centers include the Arizona Department of Public Safety dispatch center, the Maricopa County Sheriff's office dispatch center, and the city police and fire departments' dispatch centers.

Local city/county police and fire departments play a crucial role in improving transportation operations during incidents. These agencies are often the first to receive notice of an incident (as receiver of 911 calls) or the first to detect incidents because of their role in traffic patrol and traffic law enforcement. They are typically in command at the incident scene, may execute traffic control measures at the scene, request additional services, and lead crash investigations when the incident results in personal injuries, fatalities, or significant property damage.

When the emergency services dispatch center becomes aware of an incident that may have a significant impact on corridor travel, the emergency services dispatcher will contact affected TMCs upon dispatching the proper emergency vehicles and personnel,.   A significant incident is defined as one that results in the indefinite closure of more than one lane on a freeway/arterial or the closure of one lane for a period of an hour or more during peak periods.

The transportation agency may be able to provide assistance to emergency services dispatch personnel by performing the following tasks:

- Confirming the accuracy of the information, if possible, using all sources of supplementary information, including CCTV cameras in the area. This may provide an immediate assessment of the scale and severity of the incident.
- Assisting in notification of other transportation agencies that may be affected by the incident. In addition, the transportation agency may provide traffic control resources, thus freeing valuable law enforcement officers.
- Implementing a pre-determined response plan, such as traffic signal modification or the posting of messages to arterial VMS. The modification of traffic signal timing plans may allow fewer vehicles to pass through a specified intersection, thus reducing the possibility of secondary crashes.
- Continuing to monitor areas affected by the incident and provides updates accordingly.

On-scene, the emergency services personnel provide recommendations to TMCs in affected areas, requesting that certain roads or lanes be closed. Each agency TMC is able to communicate with one another through a common radio system or other existing communication devices.

The first priority of the emergency services personnel is to provide medical assistance to the injured. After medical treatment has been provided, and the accident scene secured, incident investigation teams, using total-station and photogrammetry techniques, complete investigations of fatality and critical injury crashes within two hours of the incident occurrence.

Tow-trucks that are pre-qualified to provide responsive towing of heavy vehicles are dispatched early in the clean-up and investigation process. Emergency services agencies strive to remove trucks and automobiles from the travel lane as soon as possible. If appropriate, a complete investigation may occur after the vehicles have been removed from the travel lanes.

2.4   Transit Control Center

The Transit Control Center (TCC) serves as the communications, emergency dispatch, and operations hub for the regional bus transit system.

The TCC operator ensures that normal functions are maintained by dispatching needed resources and addressing emergencies. The TCC operator maintains communication with bus drivers, maintenance crews, and police and emergency services personnel.

Transit operators may often be the first personnel arriving on the scene of an accident. The operator would report incidents to the TCC, who would then notify the appropriate emergency services agency.

Transit vehicles, by their constant presence on the road network, can also serve as "traffic probes", reporting back information about potential and actual problems. The TCC operator relays the information to the local TMCs or to the ADOT TOC.

When the TCC operator is made aware of an incident or bus breakdown, the operator will first work to ensure the safety and well-being of the transit passengers. The TCC operator will assess the situation and identify needed resources by communicating with the bus driver. The TCC operator will then communicate the latest information to emergency services personnel and provide updates as the situation progresses. The TCC operator also will inform the local TMC operator of the incident location so that signal-timing adjustments can be made, if appropriate.

Because each transit vehicle is equipped with an AVL system that uses Global Positioning System technology (GPS) the location of the bus can be pinpointed to within a few feet. If the operator determines that additional resources should be dispatched to the bus' location, he/she relays the precise location to fleet mechanics or to emergency services personnel as appropriate.

During normal operations, the AVL system will help the TCC operator to match scheduled arrival times against the actual arrival time. The TCC operator will be alerted when buses are more than five minutes behind schedule. This information will be disseminated to transit travel information services. A link from the 511 telephone service and the 511 web site directs unfamiliar travelers to the location of the transit information. The AVL system also will provide information to the TCC so that more realistic, and reliable, bus schedules can be developed and modified on a regular (semi-annual) basis.

Buses on Express Routes and Bus-Rapid Transit Routes are equipped with Transit Signal Priority Emitters. When buses are behind schedule, the level of priority can be increased. Likewise, when buses are ahead of schedule, the level of priority can be reduced or eliminated, dependent upon local traffic conditions.

Each bus is equipped with an interface terminal that tells the drivers, among other things, whether they are on time to within 1 minute. For instance, when the bus reaches a certain stop, the display might read +1, meaning that the bus is ahead of schedule by 1 minute. With the interface, a driver who is behind schedule might request that another bus wait a few minutes for the passengers he is carrying who want to connect bus routes.

The TCC operator is able to communicate with the ADOT TOC, local TMCs, and local Emergency Management Dispatch Centers. When an incident occurs on the scheduled bus route, the TCC operator can advise the driver of the incident and divert the bus to alternate routes. Transit travel information kiosks, located at the major transit hub centers, provide real-time schedule and route information. Travelers may also obtain information on transit alternatives from their desktop computers, PDA's, or from the 511 telephone service.

A communications link will also be maintained between the TCC and the State and County Emergency Operations Centers. Should an event require a mass evacuation, the TCC will coordinate with the State and County Emergency Operations Centers to ensure that transit assets are available, designate transit and emergency vehicle only corridors, and identify evacuation assembly points.

2.5 Emergency Operations Centers

The Arizona Division of Emergency Management (DEM) and the Maricopa County Department of Emergency Management (DEM) maintain Emergency Operations Centers (EOC) in the MAG region. The EOCs provide coordination and central support to field personnel during major incidents or disasters. As an example of their activities, the Arizona DEM coordinated statewide support in response to the Rodeo-Chedeski fire in the summer of 2001. The Maricopa County DEM coordinates response to potential incidents at the Palo Verde Nuclear Generating Station.

The EOCs draw upon traffic officials for support. Coordination of disaster response begins in the field. Front-line fire personnel or a transportation director might give direction to traffic personnel in TOCs. Coordination of activities is determined by the direction of the on-scene incident commander, the nature of the incident, and the time that has passed since the incident.

EOCs do not play an active, day-to-day role in traffic operations; however, effective communication between EOCs and TOCs during major incidents can be a critical factor in effective incident response. (Also, the severity of many major incidents can impact traffic operations at such a large scale that overall performance measures are impacted.) To improve coordination between transportation operations personnel and Emergency Operations Center personnel, the following activities should occur:

- Participation of traffic operations representatives from each city, the county, and the state in regular EOC activities to maintain relationships and communicate roles and available resources;
- Traffic operations staff should maintain familiarity with the County's Emergency Operations Plan and related material. This plan documents the roles and responsibilities of various participants in disaster/incident response;
- Traffic operations staff should participate in the development of Mass Evacuation Plans, currently under the guidance of Maricopa County DEM; and
- The Maricopa County DEM and the Arizona DEM should maintain communications with the ADOT TOC facilitating full motion video monitoring and control of CCTV cameras.

3. SUMMARY OF OPERATIONAL POLICIES REQUIRED TO MEET THE GOALS AND OBJECTIVES

The first three deliverables of the Regional Concept of Transportation Operations Project included the following:

- Tech Memo No. 1: Inventory of existing policies and practices in the region;
- Tech Memo No. 2: Summary of best practices for each system in the United States; and
- Tech Memo No. 3: Identification of operational goals and performance measures.

Each Technical Memorandum resulted in the identification of policies, procedures, and/or practices that are needed to improve transportation operations in the MAG region.

The following section presents a description of the policies, procedures, and/or practices identified in each Technical Memorandum.

3.1 Needed Policies, Procedures, and/or Practices Identified in Tech Memo No. 1: Vision, Mission, and Summary of Existing Regional Policies and Practices in Transportation Operations

The objective of the inventory process was to collect and document current policies, procedures, and practices related to transportation operations from the 11 MAG member agencies with freeway interchanges within their jurisdictional boundaries. These included cities, Maricopa County, the Arizona Department of Transportation (ADOT), and the Arizona Department of Public Safety (DPS).

The inventory process identified several areas that can be improved. While some areas might require large capital investments, many areas can be solved through enhanced institutional arrangements.

- **Interagency incident notification:** Potential policies and practices would facilitate communication between operational centers of multiple jurisdictions and agencies upon the occurrence of an incident that may affect multiple agencies. The affected agencies may then implement mitigation strategies, including signal-timing modification, VMS activation, and other traffic control techniques.
- **After-hours VMS operations**: Policies would establish necessary institutional arrangements so that ADOT TOC operators may post messages on city-owned arterial VMS during non-business hours.
- **After-hours traffic signal operations control**: Policies are needed that outline responsibilities for after-hours control of traffic signal systems. The policies would define who would have control at what times, under what circumstances, the level of control permitted, and any associated restrictions.
- **On-scene coordination and communications**: Practices need to be developed that facilitate the on-scene coordination between traffic management and emergency response personnel during traffic-related incidents. Practices should facilitate coordination between ADOT ALERT, Freeway Service Patrol, DPS, sheriff, and local city/county police.
- **Incident investigation response and clearance times**: Procedures should be developed that help to reduce investigation response and clearance times. These may be simple practices

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such as dispatching tow-trucks to the scene earlier in the clearance process or utilizing photogrammetry techniques for accident investigations.

▪ **Detours and diversion plans:** Policies are needed pertaining to the routing of freeway traffic onto city streets during freeway closures and restrictions. Current ADOT policy does not designate city streets as detour routes.

▪ **EVSP implementation parameters:** Policies are needed that address the regional implementation of Emergency Vehicle Signal Preemption Systems (EVSP). For safety reasons, it is important that emergency vehicle driver expectations are consistent across jurisdictional boundaries. The policy should address phasing (i.e. left-turns permitted during preempt), distance before activation of preemption, and coding.

▪ **EVSP coding and unauthorized use:** To prevent unauthorized use of the preemption system, some cities have implemented coding systems that require identification of the vehicle prior to preemption. By requiring positive identification, fire response vehicles are not able to preempt signals outside of their home city without authorization. A regional coding scheme is needed that allows cross-jurisdictional capabilities to be maintained for mutual aid. The system should be secure, minimizing unauthorized access and system abuse.

▪ **Streamlining of ADOT/local city joint project agreements**: While Intergovernmental Agreements (IGA) and Joint Project Agreements (JPA) have been developed for signals at interchanges, it is difficult for many of the individuals performing the daily operations of the traffic signal system to know what agreements exist. A process is needed that increases the accessibility of the IGAs and JPAs to those who operate the traffic signals. A potential practice may be to scan the JPA document and attach the file to a database connected with the traffic signal central control system.

▪ **Signal optimizaton across jurisdictional boundaries:** Policies for practices that facilitate signal optimization across jurisdictional boundaries are needed. Ideally, an agency could access the timing plans in a neighboring jurisdiction and implement a similar timing plan in their own jurisdiction. Standards—such as naming conventions, file formats, and signal-timing strategies—need to be agreed upon.

▪ **Center-to-center communications to enable data sharing:** Policies should define when communication and data transfer is required (accidents, congestion, special events), what data is to be transferred (traffic volumes, timing plans, location of fire trucks, traffic signal status), how the data will be sent (data definitions, what data is required to constitute a meaningful exchange), and with whom it is to be communicated to (other TMCs, transit operations, media, emergency management centers). Alternative management strategies—such as shared maintenance/joint operating agreements—should also be explored.

▪ **Input of data into HCRS**: AZTech™ workstations provide the functionality for cities to input information into the ADOT HCRS. The HCRS provides information for the 511 telephone system as well as the 511 web site. Policies and practices are needed that facilitate the input of arterial travel information into HCRS from local city and county agencies.

3.2 Needed Policies, Procedures, and/or Practices Identified in Tech Memo No. 2: Best Practices in Transportation Systems Operations

▪ **Automated DPS CAD information extraction:** Currently, because Arizona Department of Public Safety (DPS) does not have CAD, communicating freeway incident information to other agencies is done manually via telephone. A CAD system is needed that provides filtered information to the ADOT TOC, local traffic management centers, and transit control centers. At a minimum, the filtered information should contain the location of incident, time of incident, and details on road closures or openings.

- **Incident management cross training**: Policies for joint training of emergency services (police, fire)/incident management (transportation, towing) personnel from the cities, County and DPS could improve incident clearance times. Training should include education on quick clearance laws.

- **Public education of quick clearance laws**: Approximately 20 states (including Arizona) have enacted these laws. A public information campaign is needed to make sure that motorists and responders understand the law and its application. Because liability is still an issue, legislation should be sought to exempt responders from actions taken to clear roads. Both Illinois and California have good reduced liability laws.

- **Recovery class of towing vehicles:** An updating of the requirements and specifications of the heavy class of towing vehicles is needed to meet the needs of today's large vehicles. Heavy-duty towing regulations are out of date and equipment no longer adequate to upright overturned trucks in a timely manner is still allowed to operate.

- **Updated mutual aid policies for responding to new MUTCD requirements of treating incident scenes as temporary work zones:** The Millennium edition of the Manual of Uniform Traffic Control Devices (MUTCD) has made a change that impacts how traffic is managed for long-term incidents. The MUTCD states that incidents that are anticipated to last for an hour or more should be brought up to temporary work-zone standards, using the proper cones, barrels, and signs. Formal agreements between agencies may assist agencies in implementing the changes required in the MUTCD.

3.3 Needed Policies, Procedures, and/or Practices Identified in Tech Memo No. 3: Operational Goals and Performance Measures

Tech Memo No. 3 identified goals and performance measures for improved transportation operations in the MAG region. As a result of this task, several policies, procedures, and/or practices were identified that need to be implemented in order to achieve the operational goals. These policies, procedures, and/or practices are summarized below.

- **Optimize signal-timing plans within a city**: A goal was set to optimize traffic signals and coordinate them, if beneficial, on major arterials. Practices need to be introduced in order to achieve this goal.

- **Assess signal coordination within a city on a regular basis**: A goal was set to assess the signal optimization on major corridors arterials within a city. Practices need to be introduced in order to achieve this goal.

- **Optimize signal-timing plans between cities**: A goal was set to optimize signal timing on interjurisdictional arterials. Practices need to be introduced in order to achieve this goal.

- **Assess signal timing plans between cities**: A goal was set to assess the signal-timing plans on major arterials. Practices need to be introduced in order to achieve this goal.

- **Freeway incident response and clearance times:** A goal was set to reduce incident duration by 10%. Achieving this goal will require current practices to be modified and new practices to be implemented.

- **Establish integrated freeway-arterial operations:** An integrated freeway-arterial operations corridor will be implemented in the MAG region within 3 years. This will require the modification of existing policy, particularly as it relates to traffic responsive ramp-metering control and the diversion of freeway traffic onto arterials.

- **Establish an Arterial Incident Management System:** The 3-year goal, as it relates to arterial incident management, is to conduct a feasibility and planning study for a multi-

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jurisdictional arterial incident management program. Achieving this goal will require the development of policies and practices for mutual aid, as well as joint project agreements to provide funding for the regional arterial incident management program.

- **Establish a regional standard for implementation of emergency vehicle preemption system:** A regional standard will need to be developed. This will include standards for coding and vehicle identification requirements, signal phasing during preemption, and distance from the traffic signal at which preemption occurs.

- **Deploy a Transit Signal Priority pilot project:** The practice of transit signal priority will be introduced in the valley. A test corridor will need to be selected, and policies and practices relating to transit signal priority will need to be established.

- **Establish center-to-center communications**: Center-to-center communications will need to be established between 15 agencies in the MAG region. Once communications have been established, funding sources need to be identified to maintain communications. Protocols for data transfer also will need to be defined.

4. SUMMARY OF POLICIES, PROCEDURES, AND/OR PRACTICES NEEDED TO ACHIEVE OPERATIONAL GOALS

The operation of the transportation system is guided by agency policies, procedures and practices. Policies are considered written goals and intentions of the agency for a particular aspect of transportation operations. Policies could be in the form of state laws, codes, statutes, city council resolutions or documents produced by a department or agency. Procedures are written, defined steps used by agencies to implement an aspect of transportation operations. Practices are those activities that are routinely undertaken, but for which there is not a written formal document that directly describes the activities.

Stakeholders identified a need for additional policies, procedures, and practices to help achieve a regional approach to transportation operations. A summary of the needed procedures, practices, and policies is presented in **Table 2**.

Table 2 presents a summary of policies and practices that are needed to achieve the operational goals previously outlined in Tech Memo No. 3. The associated policies, procedures, and practices are subsequently expanded upon in sections 5.1 through 5.8.

Table 2 – Policies and Practices Needed to Meet Operational Goals

Category	3-Year and 5-Year Goals	Needed Policies/Practices
Freeway Mobility	Limit the percent increase in average travel time to less than the percent increase in traffic volume	• Practice of traffic responsive ramp-metering • Practices of notifying agencies and organizations of freeway incidents (see Freeway Incident Management and Multi-agency Coordination) • Policy to improve freeway incident clearance times (see Freeway Incident Management) • Practice for removing disabled transit vehicles off of freeways as quickly as possible. Procedures needed for the safe transfer of passengers from a disabled bus to a replacement bus
Arterial Mobility	Limit the percent increase in average travel time to less than the percent increase in traffic volume	• Practices to optimize signals within cities and between cities as outlined below
	Optimize traffic signal coordination within and between cities on major arterials, or where appropriate Update the traffic signal coordination within cities every two years or when the traffic volumes change by more then 5 percent	• Practice of optimizing and coordinating, if beneficial, the signals within a city on major arterials and Smart Corridors • Practice of assessing coordination every 2 years.

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Table 2 – Policies and Practices Needed to Meet Operational Goals (continued)

Category	3-Year and 5-Year Goals	Needed Policies/Practices
Arterial Mobility (continued)	Optimize traffic signal coordination between cities on major arterials, or where appropriate Update the cross-border traffic signal coordination between cities every two years or when traffic volumes along the arterial change by more than 5 percent	• Practices to optimize and coordinate, if beneficial, signal-timing plans for signals between cities on 100% of the smart corridors • Practice of grouping signals into control sections, irrespective of jurisdiction • Practices of assessing the signal-timing plan optimization and coordination every 2 years
Freeway Incident Management	Reduce incident duration by 10% (3 years) and by 20% (5 years)	• Policy for shared operations and use of CCTV cameras • Policy for extraction of DPS CAD information and importing this information to ADOT TOC • Policy for shared operations of state and local variable message signs • Practice for altering signal-timing plans during incidents • Practice for incident on-scene coordination and communications between public safety, emergency service and transportation personnel • Policy for placement of emergency vehicles at incident scenes • Policy for the removal of fatalities from accident scenes
Freeway-Arterial Interface	Establish integrated freeway-arterial corridor operations on one corridor (3 years) and on three corridors (5 years)	• Policy for integrated freeway-arterial corridor operations • Policy for ramp-metering integration with traffic signal systems at interchanges

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Table 2 – Policies and Practices Needed to Meet Operational Goals (continued)

Category	3-Year and 5-Year Goals	Needed Policies/Practices
Arterial Incident Management	Conduct a feasibility and planning study for a multi-jurisdictional arterial incident management program	• Policy for multi-jurisdictional arterial incident management program pilot project • Practice of transit operators to notify Transit Control Center of incidents and for this information to be provided to HCRS and to local TMC operators • Policy for extraction of filtered incident information from city police, fire, and county sheriff's CAD systems, where available, and for importing this information to local TMCs and Transit Control Center • Policy for altering signal-timing plans during incidents
	Establish a regional standard for implementation of emergency vehicle preemption systems (EVSP) (3 years), ensure adoption by each of the MAG member agencies, and implement I standard on 100% of signals with EVSP (5 years)	Policy for regional emergency vehicle signal preemption implementation: • Implementation Parameters • Unauthorized Use/Coding
Transit Mobility	Deploy a TSP pilot project in the MAG region (3 years) and TSP on all Express and Bus-Rapid Transit Routes (5 years) in the MAG region	Policy for implementing and operating transit signal priority system pilot project
Computer System Reliability	Operate the system with up-time of 95% — no more than 450 hours down-time per year	• Practice of system preventive maintenance • Practice of using a back-up plan for unscheduled system down-time • Practice of notifying internal or outsource maintenance staff immediately of system failures • Policies for sharing costs for center-to-center communications (maintaining connectivity and network maintenance)
	Minimize system down-time to an average of 1 hour per system failure	

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Table 2 – Policies and Practices Needed to Meet Operational Goals (continued)

Category	3-Year and 5-Year Goals	Needed Policies/Practices
Multi-agency coordination	• Establish center-to-center communications between 15 (3 years) agencies and 20 agencies (5 years) in the region (including traffic, transit, enforcement, and emergency management) • Facilitate incident and emergency response between 15 agencies (3 years) and 20 agencies (5 years) • Facilitate travel information sharing between 15 agencies (3 years) and 20 agencies (5 years)	• Practice and procedure for sharing and disseminating data and video between agencies (including detector data, real-time signal-timing plans, and video images) • Policy for after-hours traffic signal operations monitoring and control • Practice of providing notification to agencies and organizations of freeway incidents • Practice of regularly meeting with fire, police, and EMS staff within cities, state, and county
Travel Information Provision	Increase travel information usage (web, 511 TV, radio, etc.) by 100% (3 years), and by 200% (5 years)	• Policy to automate extraction of incident information from CAD systems to improve quality of travel information
	Achieve a 75 percent customer satisfaction – on a scale of 1 to 10, a score of 7 or higher is desired	
	Expand Phase 1 of the ADOT/MCDOT/City of Scottsdale web-based HCRS pilot project for local closure and restriction information to include 5 additional MAG member agencies Evaluate performance capabilities of Phase 2 web based HCRS pilot project for local closure and restriction information and expand to include additional MAG member agencies	• Practices of entering travel information, gathered by cities and towns into HCRS
	Incorporate transit status information from AVL data from all equipped buses into travel information services	• Policy for the importing of transit AVL data from Transit Vehicle Management System into 511
	Obtain travel time information on 50% of instrumented arterial roadways and post this information to web, 511, and variable message signs	• Polices for the posting of travel time information messages on VMS
	Develop web-based arterial maps for 100% of instrumented smart corridors	• Practices to collect data from instrumented smart corridors and to import the information into 511 and travel information web sites

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The following sections expand on the contents of **Table 2**. The contents of potential policies, procedures, and practices are described. When available, similar policies implemented in other areas of the country are also described. Each section begins with a review of the operational goal and is followed by a recommended practice to achieve the goal.

4.1   Freeway Mobility

Freeway mobility can be improved by constructing additional freeway lanes; however, this is not always feasible, nor desirable. Thus, freeway mobility must be improved by increasing the capacity of the freeway system through improved operations.

Potential policies, procedures, or practices that may improve freeway mobility are outlined in the following sections.

4.1.1   Goal: Limit the Percent Increase in Average Travel Time to Less than the Percent Increase in Traffic Volume

The urban freeway system serves as the backbone of the transportation system, carrying large volumes of people and goods during all hours of the day. The urban freeway system serves not only intercity and regional traffic, but also local traffic. As the population in the MAG region continues to grow, and as environmental, financial, and socioeconomic factors are considered, the construction of additional lanes becomes undesirable or even prohibitive. Under these conditions, travel time will inevitably increase, and travel speeds will decrease during peak hours. Thus, transportation professionals must strive to increase the efficiency of existing freeways.

Research and operational experience has demonstrated the effectiveness of ramp metering in maximizing the throughput of an urban freeway corridor.

Practice of Traffic Responsive Ramp Metering

The two primary objectives of ramp meters at freeway interchanges are to achieve the following:

- Control the rate at which vehicles are allowed to enter the freeway, and
- Break up the platoons of vehicles released from an upstream traffic signal.

Ramp meter control may be time-based or traffic responsive. In time-based control, metering rates are dependent upon the time-of-day and day-of-week. In traffic responsive ramp metering, rates are adjusted based on volume, occupancy, or speed data obtained from the freeway detectors.

ADOT currently operates the ramp meters on a time-of-day, day-of-week strategy. The primary criticism of preset strategies is that they may result in over-restrictive metering rates when congestion dissipates sooner than is anticipated. This may cause unnecessary ramp queuing and delays as well as loss of creditability with the travelers. This type of control is also unresponsive to increased traffic volumes, which may result in long ramp queues backing to the surface streets and interfering with traffic signal operations.

Traffic responsive ramp metering can be implemented to consider traffic on the freeway on-ramp as well as traffic conditions on the freeway mainline.

Practices governing traffic responsive ramp metering should be developed. Practices should consider the impact of ramp metering on the arterials as well as on the freeway.

Practice of Notifying Agencies and Organizations of Freeway Incident

Improved information exchange between local agencies and the ADOT TOC will result in improved freeway mobility. When local agencies (police, transportation, etc.) are made aware of a freeway incident that may affect traffic at interchanges or on arterials, they can implement appropriate response strategies. For a full explanation of this practice, please see Freeway Incident Management (section 6.3).

Policy to Improve Freeway Incident Clearance Times

Freeway incidents account for a large percentage of delay on the freeway system. Improving freeway incident management will have an immediate and direct impact on freeway mobility. The potential for adverse impacts to traffic decreases when incidents are quickly cleared, improving freeway mobility. For a full explanation of this practice, please see Freeway Incident Management (section 4.3).

Practices for Removing Disabled Transit Vehicles off Freeways

The occasional breakdown of transit vehicle on freeways presents a challenge for both motorists and transit travelers. Because of the size of transit vehicles, partial shoulder closures may be necessary until the vehicle is removed. Practices should be developed that reduce the impact of the transit vehicles to motorists, while maintaining the safety of the transit passengers. Practices should be developed that facilitate the safe transfer of passengers from the disabled transit vehicle to a replacement vehicle.

4.2   Arterial Mobility

The stakeholders in the MAG region desire to limit the change in average travel speeds and travel times on arterials. Because a large percentage of delay on arterials is due to traffic signals, improving traffic signal operations and coordination within cities and between cities will result in improved arterial mobility.

The following sections present potential policies, procedures, or practices that may be required to achieve these goals.

4.2.1   Goal: Limit the Percent Increase in Average Travel Time to Less than the Percent Increase in Traffic Volume

Delay on arterials largely emanates mainly from two sources:

- Inadequate arterial signal progression; and
- Arterial incidents.

As such, the goal of limiting the change in average travel speed and average travel time to less than the increase in traffic volumes will be achieved by improving arterial incident management (see section 4.5) and implementing in-city (section 4.2.2) and cross-border (section 4.2.3) signal coordination.

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Practices to Optimize Signals within Cities and Between Cities

The signalized intersection is generally the capacity constraint of the arterial street network. Implementing signal coordination within cities and between cities can provide significant benefits to travelers in the MAG region. Please see section 4.2.2 for an explanation of this recommended practice.

Policy to Improve Arterial Incident/Crash Clearance Times

A collaborated incident response plan can dramatically improve arterial mobility. Collaboration between police, fire, and transportation professionals to remove incapacitated vehicles and debris from the travel lanes will result in less incident-caused delay. Arterial incident clearance practices are similar to freeway incident clearance practices. For a full explanation, please see Freeway Incident Management (section 4.3).

4.2.2 Goal: Optimize traffic signal coordination within cities on major arterials, or where appropriate

The safe and efficient flow of traffic is a major concern to the local public agencies. Optimized traffic signals can have significant benefits to arterial travelers.

Practice of Optimizing and coordination, if beneficial, traffic signals within a City on major arterials and Smart Corridors, and Assessing the Coordination Every 2 Years

Because of the potential benefit that optimized traffic signals can have on the transportation system, each agency should make a commitment to regularly assess and optimize the timing plans at each traffic signal on smart corridors and major arterials. Practices should be developed for assessing the traffic signal timing plans every 2 years.

4.2.3 Goal: Optimize traffic signal coordination between cities on major arterials, or where appropriate

Case studies have shown that cross-jurisdictional signal optimization, and coordination if beneficial, is an achievable goal regardless of the number of jurisdictions involved, the type of hardware and equipment, or even the philosophical differences in timing approaches. The most important factor is cooperation and communications among the agencies.

Practice of Optimizing and Coordinating, if beneficial, Traffic Signals between Cities on major arterials and Smart Corridors

Agencies should work together to optimize and coordinate, if beneficial, traffic signals on cross-jurisdictional corridors.

Practice of Grouping of Signals into Control Sections Irrespective of Jurisdiction

Regional traffic signal coordination and optimization may be achieved by grouping arterial traffic signals into control sections. Potential arrangements might include:

1. Transfer of maintenance of intersections to neighboring jurisdictions. Mesa, for example, would be responsible for the operations and maintenance of select signals on Southern Avenue within the city limits of both Mesa and Tempe. Tempe would assume responsibility for operations and maintenance of select signals on Baseline Road, even though some of the signals lie within the political boundaries of Mesa.

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2. In a variation of the agreement outlined above, Mesa maintains several intersections for Tempe, while Tempe pays for the electricity.

The question of how to group intersections into a system of control section is complex. The objective should be to assemble those intersections requiring similar timing strategies in terms of cycle lengths and offsets into groups [5]. The following factors should be given consideration [5]:

1. Geographic relationship: The distance between intersections. Intersections with spacing of less than 1 mile should be grouped into the same control section.

2. Traffic flow characteristics: If traffic arrivals at the intersection are random throughout the signal cycle, the number of stops and amount of delay will be the same regardless of coordination efforts. If traffic arrivals on the arterial are by platoon, the benefits of coordination are enhanced.

Practice of Assessing Coordination Every Two Years

Once coordinated operations have been implemented, the coordinated plans should be reviewed and modified, at a minimum, every two years or when traffic volumes change by more than 5%.

4.3 Freeway Incident Management

Improving incident management practices is complicated by the fact that different agencies have different, and sometimes competing, objectives. For example, transportation agencies typically focus their response priorities on the restoration of normal traffic flow and minimization of delays, while the highest priority of the enforcement agencies may be to conduct a thorough incident investigation. A key to improving incident management is to help agencies understand the objectives of other agencies. Through increased understanding and communication, each agency's objectives can be achieved.

The following sections present policies and practices that can be implemented to improve incident management from the time that the incident is detected until the incident is cleared and normal traffic is restored.

4.3.1   Goal: Reduce Incident Duration by 10%

The RCTO Stakeholders have set a goal of improving freeway incident management in the MAG region by reducing incident duration and clearance times by 10%. This can be achieved by improving each of the successive steps that comprise incident management: incident detection, verification, on-site management, and incident clearance.

Incident Detection

The incident management process begins with incident detection. Detection methods may include receiving a report from a cellular or wireline telephone, receiving a report from police or freeway service patrols, or viewing an incident through the CCTV cameras.

Incident Verification

Incident verification is the determination of the nature and location of the incident. Verification is important so that emergency personnel can dispatch the appropriate response

personnel and resources to the scene. Verification reduces the deployment of resources to the wrong locations or to locations where the reported incidents are no longer there.

Where available, closed-circuit television (CCTV) is the most cost-effective and efficient method for incident verification.

Policy for Shared Operations and Use of CCTV Cameras

Where available, CCTV is the most cost-effective and efficient method for incident verification, providing timely detection or verification of an incident [1].

Policies that facilitate the verification of incidents by CCTV should be developed. Upon the reporting of an incident to the PSAP (Public Safety Answering Point) from a cellular telephone or other means, the emergency agency receiving the call must then have a means to relay the information to the TOC so that it can be verified[2]. Policies governing the provision of CCTV images directly to the PSAP should be developed. The policy should address the use of images and the secondary control of the cameras.

Communications lines should be established between the DPS CAD system (to be implemented in 2003) and the ADOT TOC that enable video to be transmitted between the centers.

Incident Response

Incident response is the activation of a planned strategy for the safe and rapid deployment of the most appropriate personnel and resources to the scene. Optimum incident response is sending the right equipment and personnel to the incident scene quickly; over-responding to incidents (dispatching more resources than is necessary) or under-responding (not sending enough resources) results in increased cost and degrades the effectiveness of the response. Optimum response depends on accurate and rapid verification, as well as coordinated agency planning and communication [1].

Because of the numerous agencies and elements that comprise a complete emergency response plan, information management plays an important role in response by providing the necessary details to the appropriate response personnel. To facilitate information management during incidents, the following policies and practices should be developed.

Policies should be developed that govern interagency response to incidents. The policy may call for the development of a set of interagency response action plans. The policy should encourage the sharing of data and outline responsibilities for joint operations of ITS field elements including CCTV, VMS, and traffic signal systems.

Specific policies that should be developed as part of the above policy include:

Policy for Extraction of DPS CAD Information and Importing this Information to ADOT TOC

A policy should be developed that allows for filtered CAD information to be extracted from the DPS CAD system and imported into the appropriate interface at the ADOT TOC. Only information such as the incident location, time of incident, incident type, and the number of lanes affected would be viewable to the TOC operator.

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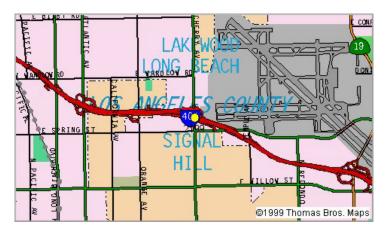Operational Goals
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As an example of an emergency/enforcement agency providing real-time information to transportation agencies, the Washington State Patrol provides incident data from the CAD system to TOC operators. The incident data provided includes the following:

- Incident Identification Number;
- Incident type: traffic hazard, traffic collision;
- Incident Location; and
- Responder assigned to handle the incident.

The California Highway Patrol (CHP) provides filtered CAD information to the Internet. The following map is an example of an incident on the CHP web site that is monitored by the TOC.

Incident data accompanying the map included:

- Incident Identification Number: 2199
- Incident type: traffic hazard, traffic collision
- Time of current information: 1/22/03 5:04:22 P.M.
- Additional details:
    - 3:27 P.M. Roadway Clear
    - 3:19 P.M. PLS Roll CHP
    - 3:10 P.M. Gray Ford Taurus #1 Lane
- Responding Officer Status: Officer en-route

The Arizona DPS has begun planning for a statewide CAD system. However, funding has not been identified. Efforts should be made to ensure that the planned system will be capable of exporting filtered information to other agencies.

Policy for Shared Operations of State and Local Variable Message Signs

A policy for shared operations (including after-hours) of VMS should be developed.

Shared-use of freeway and arterial VMS can provide benefits to partnering agencies. The state will benefit during incidents by being able to warn motorists of incidents before they enter the freeway. Likewise, the city will be able to warn motorists of incidents before they exit the freeway and move onto the congested route.

Potential guidelines for shared use/access of VMS used for the purpose of providing alternate route information during incidents may include:

- Establishment of message library between partnering agencies. Messages on VMS should be closely coordinated to provide message continuity.
- The device owner (whether state or city) will have final authority to change messages on the VMS.
- In the event that the state desires to preempt the city's message, the state will notify the city.
- When the city desires to post a message on state-owned VMS, the city will submit a request that a message be placed on the VMS from a pre-approved list of messages. A custom message to suit a specific incident may be posted if it is agreeable to both agencies. The city also will notify the state when the requested message is no longer required.
- VMS Software will be set such that any personnel with an access code will be able to monitor the signs from a remote workstation. This will allow local police departments and other city traffic personnel to request that messages be posted. The city should provide the state with a list of personnel who are authorized to request messages.
- Default settings, messages, and hours of operation should be identified as part of the detailed operating procedures. Activation criteria also should be established. Situations that may warrant VMS activation include:
  - Single lane (mainline or ramp) or multiple lanes blocked, or complete closure of either direction;
  - Any incidents causing backups on one-half mile or more (e.g. accident, fire, etc.);
  - Any fatal or multiple injury accidents;
  - School bus accidents with injuries or fatalities involved;
  - Spills/shifted loads including hazardous material or chemical spills;
  - Large debris blocking lane/ramp for extended periods (i.e. trees, power lines, etc.);
  - Rain, fog, smoke, or wind conditions on the roadway that impact highway safety;
  - Major special events affecting highway traffic conditions (non-recurrent);
  - Planned closures, etc.; or
  - Any partial or full closure lasting 30 minutes or more.

Practice for Altering Traffic Signal Timing Plans during Incidents

During incidents on the freeways, arterial traffic volumes may increase beyond that which the normal signal-timing plan was developed to manage. Collaboration between local agencies for signal-timing adjustments at intersections can result in improved freeway and arterial mobility during incidents.

In order to facilitate interagency collaboration, a consistent, region-wide signal-timing structure that addresses a specific direction of traffic should be developed.

For example, the structure would call for the development of the following:

- Three AM peak plans – 1, 2, 3;
- Three mid-day plans – 4, 5, 6; and
- Three PM peak plans – 7, 8, 9.

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In the region-wide signal-timing structure, plans 1, 4, and 7 would be the timing plans for normal operations. Plans 2, 5 and 8 would favor northbound and southbound traffic, and plans 3, 6, and 9 would be developed to favor eastbound and westbound traffic.

These nine plans would handle most of the traffic patterns that are common to a typical day. Additional plans, plans 10 through 20 for example, would be designed to manage traffic volumes during special events or incidents. These plans would allot a large percentage of the green time to specific movements.

Incident Scene and Site Management

Scene management is the management of resources to remove the incident and reduce the impact on traffic flow. Effective scene management coordinates the activities of multiple responding agencies and personnel, and provides for their safety at the incident scene [1].

In large incidents, the Incident Command System is implemented with police or fire "in charge" of the scene. A command post is designated to centralize incident communications and facilitate communications among the different responding agencies [1].

Practices for Incident On-Scene Coordination and Communications

Emergency services personnel (police and fire) are well rehearsed in the Incident Command/Unified Command Systems; members of transportation agencies may not be as well-trained. Aggravating a lack of coordination is the fact that many of the incident response components (police, fire, towing, and transportation) are dispatched independently and on-scene communication between these response components may be sporadic.

Imperative to effective on-scene management is the ability for police, fire, and transportation professionals to have common means of communication. A Public Safety Communications Committee, consisting of high-level public safety officials from around the state has been organized to develop a state-wide communications needs assessment study. An ADOT representative also serves on the committee. ADOT ALERT and FSP should adopt practices for on-scene communications that are consistent with the committees' findings.

Policy for Placement of Response Vehicles at Incident Scenes

Upon arrival at an incident scene, emergency vehicles may be used to protect the incident site and responders, to deliver equipment to the scene, or to perform recovery and clearance. Proper vehicle placement can be critical to the smooth flow of traffic around the site. In general, vehicles should be placed to protect the scene and provide access to needed equipment while minimizing the number of lanes occupied by the emergency vehicles. Since incidents are nearly always unique, a hard and fast set of rules regarding vehicle placement would be difficult to understand and apply; however, responders should consider vehicle placement when arriving at an incident scene[2].

When arriving at the incident scene, responders should first evaluate what other responders have already arrived. If an emergency agency has already protected the scene, the responder should make every attempt to minimize distraction or additional lane restrictions that might result from the placement of the arriving vehicle [2].

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A policy should be developed that gives consideration to vehicle placement at incident scenes. Each individual agency should develop specific practices for vehicle placement.

Incident Clearance

Incident clearance is the safe and timely removal of vehicles, wreckage, debris, or spilled material from the roadway and its shoulders, and the restoration of the roadway to its full capacity. It has been shown that incident clearance is typically the most time-consuming step in the incident management process. Thus, a reduction in clearance times can have a large benefit on the transportation system [1].

Specific projects that would result in improved clearance times are outlined in Section 7.

Policy for the Removal of Fatalities from Accident Scenes

Policies for the removal of fatalities from accident scenes should be reviewed and modified. In many cases, accidents can be cleared much sooner if emergency services personnel are authorized to move fatalities from the roadway prior to arrival of the coroner. Current policies require the County Medical Examiner to remove the fatalities from the incident scene.

4.4 Freeway-Arterial Interface

State transportation agencies are predominately focused on freeways, and as a result few employ integrated arterial signal control for traffic management; however, integrated operations can provide significant benefits to the transportation system, particularly during incidents.

The objective of integrated freeway-arterial incident management systems is to jointly maximize the available capacity of freeways and arterials in order to minimize delay for motorists traveling through the corridor during incidents. Although there are variations, the basic components of an integrated freeway-arterial incident management system include:

- Detection of major incidents on freeways;
- Routing of motorists to parallel arterials using freeway variable message signs (VMS) or other means;
- Adjusting signal-timing plans and ramp-metering rates to accommodate the increase in arterial traffic; and
- Use of arterial VMS and lane control signals to inform motorists when and where to re-enter the freeway. At present, however, case studies have shown that these devices alone seldom provide motorists sufficient information to alter travel plans. Other means of informing motorists should be explored.

4.4.1　　Goal: Establish Integrated Freeway-Arterial Corridor Operations

Integrated freeway-arterial operations refers to the establishment of communications between the arterial traffic signal system and the freeway management systems (ramp meters, variable message signs) to more efficiently manage traffic at the freeway-arterial interface.

Policy for Integrated Freeway-Arterial Corridor Operations

For freeway-arterial integrated operations to be implemented on a test arterial, a policy between the partner agencies will need to be developed. In the policy development, consideration should be given to the following areas:

1. How collection of freeway and arterial traffic data will occur;

2. How incidents and congestion will be detected; and

3. How the system will be operated, including considering the development of pre-defined response scenarios, and whether traffic signal-timing and ramp-metering rates can be easily changed based on the pre-defined scenarios

The implementation plan developed for the SR-91 La Palma Smart Corridor (California) outlines principles of integrated freeway-arterial operations. These included the shared use of ramp meters and the traffic signal system, based on the following principles:

- Caltrans will provide the City with Traffic Advisory information along the corridor to allow the City to alter signal-timing (timing plans, offsets, force-offs) upstream and downstream along the corridor as required by the event.

- In the event that ramp meter traffic backup interrupts surface street signal operation, the City will request Caltrans either for an automatic central override or manual input central override. Caltrans can also ease the restrictive metering so that ramp queues do not cause backup onto the arterial.

- In the event that surface street signal-timing makes the exit ramp backup into the freeway mainline, Caltrans will request the city to change the green time on the mainline to facilitate reduced queue lengths on freeways.

- Each agency can monitor the others' traffic signal-timing plans along the corridor. On those occasions when the timing parameters can be changed to maximize traffic flow in the corridor, any such changes should be pre-approved or authorized by the other agency.

- The City can access and monitor Caltrans ramp metering rates but will not be able to change or alter the rates.

Policy for Ramp-Metering Integration with Traffic Signal Systems

The integration or coordination of signal systems with ramp-metering control can result in improved arterial-freeway operations. A policy should be developed between the local cities and ADOT that govern coordination techniques and practices.

4.5   Arterial Incident Management

Many of the principles that have been outlined in Freeway Incident Management (section 4.3) are also applicable to arterial incident management.

4.5.1 Goal: Conduct a feasibility and planning study for a multi-jurisdictional arterial incident management program

Policy for a multi-jurisdictional Arterial Incident Management System Pilot Project

The feasibility of a multi-jurisdictional arterial incident management system should be conducted. Although REACT has been implemented as a pilot project in the west valley, a formal, multi-agency traffic incident program should be considered for the rest of the valley.

The feasibility study and program should receive the endorsement of, participation from, and coordination by senior agency management from all of the participating agencies. The feasibility study should address the following:

- Development of a written and endorsed strategy;
- Development of a plan to implement the strategy;
- Gaining support and ongoing participation in program direction from agency senior executives;
- Documenting roles and responsibilities of participants;
- Establishment of program goals and objectives;
- Performance evaluation; and
- "Mainstreaming" funding, if feasibility study proves beneficial

Practices for Transit Operators to Notify Transit Control Center of Incidents

Increased detection and verification is critical to improving arterial incident management performance. Because of the number of transit vehicles on the street network, transit vehicles may present an opportunity for additional network surveillance.

Practices should be established that encourage transit operators to report traffic information like incidents or congestion to the Transit Control Center. This information should be provided to local TMC operators and input to HCRS. When transit operators become aware of an incident or area of congestion, they should be trained to provide accurate and relevant information to the TCC.

Policy for Extraction of Filtered Incident Information from City Police, Fire, and Sheriff CAD Systems to Local TMCs and TCC

Automated extraction of incident information from local city police, fire, and Sheriff CAD systems, where available, would improve interjurisdictional response to arterial incidents.

To accomplish this goal, a policy should be developed by representatives of cities, police, and fire to govern the extraction of filtered CAD information. This is similar to the policies and practices outlined in Freeway Incident Management (Section 4.3).

Policy for Altering Signal-Timing Plans during Incidents

Development of a region-wide signal-timing structure that allows for the alteration of signal-timing at intersections during incidents will facilitate arterial incident management. The signal-timing structure was outlined in the Freeway Incident Management (section 4.3).

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4.5.2 Goal: Establish a Regional Standard for Implementation of Emergency Vehicles Preemption Systems (EVSP)

Policy for Regional Emergency Vehicle Preemption System Implementation

Emergency vehicle signal preemption refers to the process by which emergency vehicles, equipped with a transponder, interrupt normal traffic signal operations. During preemption, the traffic signal may enter into an all-red phase, such that the signals at all legs of an intersection are red. Alternatively, preemption may be implemented such that the traffic signal shows green on the legs of the approaching emergency vehicle.

Emergency vehicle signal preemption systems have been widely deployed in the MAG region; however, no region-wide policy or practice has been adopted concerning EVSP. A policy that outlines the objectives and principles of emergency vehicle preemption systems should be developed.

Upon development of a governing policy, specific practices can be developed. Specific areas that should be addressed include implementation parameters and vehicle identification coding to prevent unauthorized use of the system.

Implementation parameters: While ADOT has developed some guidelines for the implementation of EVSP on ADOT routes, there is no common, agreed upon implementation of the EVSP within the numerous municipalities. For safety reasons, it is important that emergency vehicle driver expectations are consistent across jurisdictional boundaries and throughout the region. This is particularly important because of the high degree of cooperation among fire departments throughout Maricopa County. The policy should address phasing during preemption (i.e. left-turns permitted during preempt), distance before activation of preemption, and coding/vehicle identification requirements.

Vehicle Identification Coding: In order to prevent unauthorized use of the preemption system, many cities have implemented coding systems that provide positive identification of the vehicle prior to preemption. By requiring positive identification, fire response vehicles are not able to preempt signals outside of their home city without authorization. A regional coding scheme is needed, such that cross-jurisdictional capabilities are maintained for mutual aid. The system should be secure, minimizing unauthorized access and system abuse. Staff at the City of Mesa has developed a proposed uniform coding procedure for preemption (Proposed Code Assignment List, Revised May 9, 2002). This may provide a basis for a regional EVSP coding schema.

The document lists the following implementation goals:

- Maintain cross-jurisdictional capabilities for mutual aid.
- Provide flexibility for cities to, within their borders, allow (or not allow) access to the system to various users. Cities should be able to determine their own unique combination of access by:
    - Fire department
    - Police
    - Ambulance
    - Transit (buses)
    - other users
- Provide positive (unique) identification of vehicles, regardless of organization.

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- Provide an identification schema that allows for growth in:
    - Number of vehicles using the system
    - Areas of implementation (cities, counties, and etc.)
- Provide a more secure system whereby the chances of unauthorized access and system abuse are limited as much as possible.

The coding schema presented by City of Mesa staff should be reviewed and modified based upon stakeholder input, formalized, and then adopted on the regional level.

4.6 Transit Mobility

4.6.1 Goal: Deploy a TSP Pilot Project in the MAG Region

Transit Signal Priority (TSP) is an operational strategy that facilitates the movement of transit vehicles through traffic-signal controlled intersections. Although priority and preemption are often used synonymously, they are different processes. Transit signal priority modifies the normal signal operation to better accommodate transit vehicles, while preemption interrupts the signal operation [4].

Expected benefits of TSP include improved schedule adherence and reduced travel time for buses, leading to increased transit quality of service. Negative impacts consist primarily of impacts to other traffic, generally on cross streets, which face the potential of increased delay at traffic signals [4].

Policy for Implementing and Operating a Transit Signal Priority Pilot Project (TSP)

Prior to implementing transit signal priority, a policy for TSP implementation should be developed jointly by traffic engineering and transit professionals. The policy should address the following:

- Stakeholder roles and responsibilities;
- Objectives of the TSP pilot project, including anticipated benefits and acceptable costs and impacts;
- Basic criteria used to evaluate the success of TSP deployment;
- Interagency relationships, including operations and maintenance;
- Regional management and coordination;
- Implementation planning; and
- Procurement.

4.7 Computer System Reliability

The transportation system is a collection of various elements and systems that work harmoniously to provide one or more services. Elements include, but are not limited to, the communications network, ramp-metering systems, loop detectors, VMS, CCTV, and traffic signal systems.

4.7.1 Goal: Operate the System with Up-Time of 95%, and Minimize System Down-Time to an Average of 1 Hour per System Failure

Practice of System Preventive Maintenance

To maintain the system at a high level of service, practices of preventive maintenance should be developed. Practices may include regular and routine testing of system elements to detect potential weaknesses before they fail.

Practice of Using a Back-Up Plan for Unscheduled System Down-Time

Back-up plans should be in place so as to minimize the impact to traffic when system elements fail.

Practice of Notifying Internal or Maintenance Staff Immediately of Failures

When failures occur, maintenance staff—whether internal or out-sourced—should be notified immediately. For critical system elements provided by contract (i.e. leased lines by Qwest, etc.), every effort should be taken to see that the problem is corrected as soon as possible. Maintenance and response requirements should be considered for inclusion in the lease or purchase contracts.

4.8 Multi-agency Coordination

Regional collaboration is imperative to improving transportation operations. For example, during normal operations two-way communication must occur if the ramp meter systems are to coordinate with the traffic signal system. The importance of two-way communication is enhanced during incidents and times of emergency.

4.8.1 Goal: Establish Center-to-Center Communications

In order to facilitate interagency communication and data sharing, center-to-center communications should be established between agencies in the MAG region.

Policy of Sharing and Disseminating Data and Video between Agencies, Including Detector Data, Real-Time Signal-Timing Plans, and Video Images

Policies and practices should be implemented that facilitate the transfer of signal and detector data, real-time signal-timing plans, and video images between agencies. Shared use of video images will allow all agencies to obtain as much information as possible so that they may react accordingly. In addition, allowing multiple agencies to view the real-time signal-timing plans operating at a specific intersection will enable them to make changes to their own system if needed.

Policies should define when communication and data transfer is required (accidents, congestion, special events), what data is to be transferred (traffic volumes, timing plans, location of fire trucks, traffic signal status), how the data will be sent (data definitions, what data is required to constitute a meaningful exchange), and with whom it is to be communicated to (other TMCs, transit operations, media, emergency management centers). Alternative management strategies, such as shared maintenance/joint operating agreements, should also be explored.

4.8.2 Goal: Facilitate Incident and Emergency Response between Agencies

Policies for After-Hours Traffic Signal Operations Monitoring and Control

Policies should be developed that allow for the after-hours monitoring of traffic signal systems by the ADOT TOC. In the case of an incident that has a significant impact on arterial traffic (i.e. complete freeway closure), ADOT would be able to implement appropriate changes. The policy should address what changes would be permitted, under what circumstances, who would be able to make the changes, and procedures for notification of the owning agency of any changes made. The development of a region-wide signal-timing structure would facilitate after-hours traffic signal modifications.

Practices of Providing Notification to Agencies and Organizations of Freeway Incidents

Practices of providing notification to agencies and organizations of freeway incidents should be developed. For example, when an incident is detected and verified on the Loop 101 within the City of Scottsdale boundaries that may affect arterial traffic, ADOT should notify the traffic engineers at the Scottsdale TMC. Scottsdale will then be able to decide what changes to the traffic signal-timing plans need to be implemented to accommodate for the increased traffic volumes.

Practices of Regularly Meeting with Fire, Police, and EMS Staff within Cities, State, and County

Practices should be established of regularly meeting with fire, police, and emergency services staff within cities, county, and state. This could be done through a multi-agency working group that includes senior members of fire, police, and transportation agencies. The group would meet to discuss methods and techniques to improve transportation operations, particularly incident management. Through such interjurisdictional cooperation, individuals will gain a better knowledge of other agencies' concerns, thus improving understanding and cooperation.

4.8.3 Goal: Facilitate Travel Information Sharing between Agencies

Providing improved travel information is a priority in the MAG region. Specifically, the stakeholders would like to increase travel information usage and increase customer satisfaction. This is largely accomplished by providing more current and extensive information.

4.9 Travel Information Provision

4.9.1 Goal: Increase Usage by 100% and Achieve 75% Customer Satisfaction

The following items were recommended[3] to serve as guidelines for the expansion of Travel Information Systems in the MAG region.

Concentrate on Data Availability and Quality

Collecting and providing accurate, up-to-date, and thorough information is the most essential issue facing the architects of any ATIS product. Work to collect the most information from as many sources as possible. Data from arterials is just as important as data from limited access highways, and the travel information system should be poised to provide the best arterial data infrastructure in the nation. Include a truly multimodal

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product that offers information on transit, paratransit, and weather conditions in addition to roadway information.

Provide a Basic Service in Availability and Quality

ITS industry standard suggests a comprehensive ATIS product be available in the form of an interactive web site and an IVR (Interactive Voice Response) system. ATIS information in the region should be accessible to anyone with a phone and anyone with Internet access. Basic quality standards must be adhered to so that the product disseminated is consistent no matter what the method of dissemination.

Create a Long-Term Coalition of ITS Stakeholders

Representatives from local agencies such as transportation, emergency services, air quality, and media outlets should be included in an active coalition, attend regular meetings in order to share their needs and concerns, and participate in plans of action to meet those needs.

Tailor the Product to Meet the Needs of the Consumer

Identify the consumer, and find out his/her needs and desires. Gather focus groups of travelers in the Valley to find out what they want from information services. Allow for updated gathering of this data so trends can be tracked over time and information shared with potential partners. Users need to know the following information first and foremost: How congested is the traffic ahead, and how long will it take me to get from point A to point B? Incident data is important, but it is the effects of incidents that make traffic news. Concentrate on giving the user congestion or impact-related information first, followed by secondary incident details. Automatic systems should be constructed so that impact data is given first.

Rely First and Foremost on Public Funds

The accurate and timely dissemination of ATIS data is the responsibility of public agencies, but is an opportunity for private firms. Public agencies have a responsibility to the customer with regard to ATIS dissemination. The more travel information disseminated the better for the traveling public, the infrastructure, and the economy.

Concentrate on Arterial Coverage

The MAG region covers a great deal of arterial road miles in addition to the limited access freeways miles. Those arterial roads need the benefit of ATIS equipment and service just as much as freeways.

Fund an Aggressive and Sustained Marketing Campaign

Marketing and promotion is a greatly under-appreciated and underused tool in the dissemination of ATIS products. Marketing is an absolutely critical factor in determining use rates for ATIS. It is necessary to appreciate the importance of diverting enough time and funds to market the product and convince the community to use it. Advertising and promotion is clearly the biggest factor in determining if the populace becomes users, and consequently beneficiaries, of the services.

Service is Exclusively Private or Exclusively Public

A commitment to a collaborative partnership between interests allows new ideas and perspectives to emerge. When both are involved in an open-architecture format, it is then

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possible to leverage the contribution of both types of partners so as to create the most useful product. Bringing together many diverse private companies that complement each other results in a broad and thorough output.

It is imperative to interview public stakeholders and representatives from private companies regarding the product. Develop a comprehensive outreach program for public and private parties to participate in effective deployment of the program.

Use Advances in Technology

Keep on staff or contract out technical project managers who can advise stakeholders on advances in communications and other related industries. Rely on the services of a web designer or design company to regularly update the traffic web sites. The aesthetics of a web site are crucial to the user experience and, by extension, to the usefulness of the product. WSDOT in Seattle and CommuterLink in Salt Lake City stand out as exceptional web sites.

Hold a Series of Focus Groups throughout Maricopa County, and Implement a Customer Satisfaction Survey

Identify the active customer and services currently offered that are the most widely-used. Identify further the services Valley residents would like to see made available.

Improve the 511 Web Site

Streamline the graphical interface, and bring the graphics and services up to standard.

4.9.2   Goal: Expand Phase I of the ADOT/MCDOT/Scottsdale web-based HCRS

Practices for the Input of Arterial Data into HCRS

The majority of agencies with AZTech™ workstations do not use the workstations to enter work zone and restriction data into the HCRS system. Some agencies have proposed that that the HCRS workstations be incorporated into the right-of-way permitting process. Practices should be developed that facilitate the input of arterial travel information into HCRS.

Practices to Collect Data from Instrumented Smart Corridors

In order to improve the quality of travel information in the MAG Region, practices should be developed for the collection of data from arterial detectors and the input of this information into 511 and travel information web sites.

4.9.3   Goal: Incorporate Transit Status Information from AVL Data into Travel Information Services

Policy for the Incorporation of Transit VMS AVL Data into 511

Transit agencies and travel information providers should develop a policy for the incorporation of real-time transit data into the 511 system. There are several basic issues that the policy should address:

- What data will be contained on the system;
- Will the information be incorporated into the system, or will the caller be transferred to the transit agency telephone system; and

- How often the data will be updated.

4.9.4 Goal: Obtain Travel Time Information on Instrumented Roadways and Post to Web, 511, and Variable Message Signs

Policies for the Posting of Travel Time Information Messages on Variable Message Signs

Policies should be developed for the posting of travel time information on freeway variable message signs.

Policy to Automate Extraction of Incident Information from CAD Systems

As explained in Freeway Incident Management (section 4.3), a policy should be developed that allows for the extraction of filtered CAD information from DPS and local city police and fire agencies.

4.9.5 Goal: Develop Web-based Arterial Maps for 100% of Instrumented Smart Corridors

Practices for Travel Time Information Collection and Dissemination

Practices should be developed to collect data from instrumented smart corridors and to import the information into 511 and travel information web sites.

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